CLAIMS

We claim:

1. A cooling system for use with a microwave antenna, comprising:

a cooling jacket adapted to at least partially surround a microwave antenna,

wherein the cooling jacket is further adapted to retain a cooling fluid therein such that at least a portion of the microwave antenna is in fluid contact with the cooling fluid.

2. The system of claim 1 further comprising at least one inlet lumen and at least one outlet lumen each in fluid communication with the cooling jacket for circulating the cooling fluid therethrough.

3. The system of claim 2 wherein a distal end of the inlet lumen is positioned near or at a distal end of the microwave antenna.

4. The system of claim 2 wherein a distal end of the outlet lumen is positioned proximally of the microwave antenna distal end.

5. The system of claim 2 wherein the inlet lumen is defined along an outer surface of the cooling jacket.

6. The system of claim 2 wherein the inlet lumen is defined within a wall of the cooling jacket.

7. The system of claim 1 further comprising a tip at a distal end of the cooling jacket.

8. The system of claim 7 wherein the tip is tapered.

9. The system of claim 7 further comprising a power generator in electrical communication with the tip.

10. The system of claim 7 wherein a distal end of the microwave antenna is securable to a proximal portion of the tip.

11. The system of claim 10 wherein the tip is adapted to be in electrical communication with the distal end of the microwave antenna.

12. The system of claim 1 further comprising a handle assembly for attachment to a proximal end of the cooling jacket.

13. The system of claim 12 wherein the handle assembly defines at least one lumen therethrough which is in fluid communication with the cooling jacket.

14. The system of claim 1 further comprising a pump for circulating the cooling fluid through the cooling jacket.

15. The system of claim 1 wherein the cooling fluid comprises a liquid, gas, or combination thereof.

16. The system of claim 15 wherein the liquid comprises water or saline.

17. The system of claim 15 wherein the gas is selected from the group consisting of nitrous oxide, nitrogen, and carbon dioxide.

18. The system of claim 1 further comprising a temperature sensor for sensing a temperature of the system.

19. The system of claim 1 further comprising an introducer which is insertable into the cooling jacket.

20. The system of claim 1 wherein the cooling jacket is configured in length to match a radiating portion of the microwave antenna.

21. The system of claim 1 wherein the cooling jacket defines at least a first and a second region adjacent to and separate from one another, the first region being adapted to retain the cooling fluid from a first source in fluid contact with a first portion of the microwave antenna, and the second region being adapted to retain cooling fluid from a second source in fluid contact with a second portion of the microwave antenna.

22. The system of claim 21 wherein the cooling fluid from the first source is maintained at a first temperature and the cooling fluid from the second source is maintained at a second temperature.

23. The system of claim 21 wherein the cooling jacket defines a plurality of additional regions adjacent to and separate from one another.

24. The system of claim 1 wherein the cooling jacket defines at least a first and a second region adjacent to and separate from one another, the first region being adapted to retain the cooling fluid from a first source in fluid contact with a first portion of the microwave antenna, and the second region being adapted to retain cooling fluid from the first source in fluid contact with a second portion of the microwave antenna.

25. A method of cooling a microwave antenna, comprising:

providing a cooling jacket adapted to surround a microwave antenna at least partially along a length of the microwave antenna; and

flowing a cooling fluid through the cooling jacket such that the fluid is retained within the cooling jacket and directly contacts at least a portion of the microwave antenna.

26. The method of claim 25 further comprising advancing the cooling jacket with the microwave antenna into a tissue region to be treated prior to flowing the cooling fluid through the cooling jacket.

27. The method of claim 25 further comprising flowing the cooling fluid through the cooling jacket prior to advancing the cooling jacket with the microwave antenna into a tissue region to be treated.

28. The method of claim 25 further comprising flowing the cooling fluid through the cooling jacket while advancing the cooling jacket with the microwave antenna into a tissue region to be treated.

29. The method of claim 26 wherein advancing the cooling jacket comprises energizing a tip positioned at a distal end of the cooling jacket to cut through tissue.

30. The method of claim 25 further comprising energizing the microwave antenna prior to flowing the cooling fluid through the cooling jacket.

31. The method of claim 25 further comprising energizing the microwave antenna while flowing the cooling fluid through the cooling jacket.

32. The method of claim 25 wherein flowing the cooling fluid comprises pumping the cooling fluid through the cooling jacket.

33. The method of claim 25 wherein flowing the cooling fluid comprises passing the fluid through an inlet lumen into the cooling jacket.

34. The method of claim 33 wherein passing the fluid through the inlet lumen comprises passing the fluid through the inlet lumen defined along an outer surface of the cooling jacket.

35. The method of claim 33 wherein passing the fluid through the inlet lumen comprises passing the fluid through the inlet lumen defined within a wall of the cooling jacket.

36. The method of claim 33 further comprising passing the fluid through an outlet lumen out of the cooling jacket.

37. The method of claim 25 wherein the fluid is statically retained within the cooling jacket.

38. The method of claim 25 wherein flowing the cooling fluid comprises flowing the fluid at a uniform flow rate.

39. The method of claim 25 wherein flowing the cooling fluid comprises flowing the fluid at an intermittent flow rate.

40. The method of claim 25 wherein the fluid directly contacts a radiating portion of the microwave antenna.

41. The method of claim 25 wherein the fluid directly contacts a shaft portion of the microwave antenna.

42. The method of claim 25 further comprising sensing a temperature of the microwave antenna.

43. The method of claim 42 further comprising initiating an alarm upon the temperature reaching a predetermined level.

44. The method of claim 25 further comprising flowing the cooling fluid through a second portion of the cooling jacket such that the fluid is retained within the second portion and directly contacts at least a second portion of the microwave antenna.

45. The method of claim 25 further comprising removing the microwave antenna from a tissue region.

46. A cooling sheath system for use with a microwave antenna, comprising:

a first tubular member defining an antenna lumen therethrough, the first tubular member being adapted to at least partially surround the microwave antenna;

a second tubular member positioned about a length of the first tubular member; and

a fluid channel defined between the first tubular member and the second tubular member,

wherein the fluid channel is adapted to retain a cooling fluid therein and envelope at least a portion of the antenna lumen.

47. The system of claim 46 further comprising at least one inlet lumen in fluid communication with the fluid channel.

48. The system of claim 47 wherein a distal end of the inlet lumen is positioned near or at a distal end of the fluid channel.

49. The system of claim 47 further comprising at least one outlet lumen in fluid communication with the fluid channel.

50. The system of claim 49 wherein a distal end of the outlet lumen is positioned near or at a proximal end of the fluid channel.

51. The system of claim 46 wherein the second tubular member is coaxially positioned about the length of the first tubular member.

52. The system of claim 46 wherein a distal end of the first tubular member and a distal end of the second tubular member are attached together.

53. The system of claim 46 wherein a proximal end of the second tubular member is attached along an outer surface of the first tubular member.

54. The system of claim 46 wherein the antenna lumen is adapted to conform to a shape of the microwave antenna.

55. The system of claim 46 wherein the fluid channel is concentrically defined between the first tubular member and the second tubular member.

56. The system of claim 46 further comprising a pump in fluid communication with the fluid channel.

57. The system of claim 46 wherein the first tubular member and the second tubular member are integrally fabricated together.

58. The system of claim 46 wherein the first tubular member and the second tubular member are comprised of a metallic material.

59. The system of claim 46 wherein the first tubular member and the second tubular member are comprised of a polymeric material.

60. The system of claim 46 wherein the first tubular member and the second tubular member are comprised of a ceramic material.

61. The system of claim 46 further comprising a hub connected to a proximal portion of the system.

62. The system of claim 61 further comprising an adjustable securing member positioned on the hub which is adapted to inhibit movement of at least the first tubular member relative to the microwave antenna.

63. The system of claim 46 wherein the antenna lumen is adapted to surround a shaft portion of the microwave antenna.

64. A method of cooling a microwave antenna, comprising:

providing a cooling sheath adapted to surround a microwave antenna at least partially along a length of the microwave antenna; and

flowing a cooling fluid through the cooling sheath such that the fluid is retained within a fluid channel defined between an outer jacket and an antenna lumen positioned within the outer jacket, wherein the fluid channel envelopes at least a portion of the length of the antenna lumen.

65. The method of claim 64 further comprising advancing the cooling sheath with the microwave antenna into a tissue region to be treated prior to flowing the cooling fluid.

66. The method of claim 64 further comprising energizing the microwave antenna prior to flowing the cooling fluid through the cooling sheath.

67. The method of claim 64 further comprising energizing the microwave antenna while flowing the cooling fluid through the cooling sheath.

68. The method of claim 64 wherein the fluid is retained within a concentrically-defined fluid channel.

69. The method of claim 64 wherein flowing the cooling fluid comprises pumping the cooling fluid through the cooling sheath.

70. The method of claim 64 wherein flowing the cooling fluid comprises passing the fluid through an inlet lumen into the cooling sheath.

71. The method of claim 70 further comprising passing the fluid through an outlet lumen out of the cooling sheath.

72. The method of claim 64 wherein the fluid is statically retained within the cooling sheath.

73. The method of claim 64 wherein flowing the cooling fluid comprises flowing the fluid at a uniform flow rate.

74. The method of claim 64 wherein flowing the cooling fluid comprises flowing the fluid at an intermittent flow rate.

75. The method of claim 64 further comprising conforming the cooling sheath to an outer surface of the microwave antenna prior to flowing the cooling fluid.

76. The method of claim 64 further comprising securing the cooling sheath to the microwave antenna to inhibit movement of the cooling sheath relative to the microwave antenna prior to flowing the cooling fluid.

77. The method of claim 64 further comprising removing the microwave antenna from a tissue region.